VALLIAMMAI ENGINEERING COLLEGE
DEPARTMENT OF CIVIL ENGINEERING

SUBJECT CODE: CE6303 **YEAR : II**

SUBJECT NAME: MECHANICS OF FLUIDS **SEM : III**

QUESTION BANK
(As per Anna University 2013 regulation)

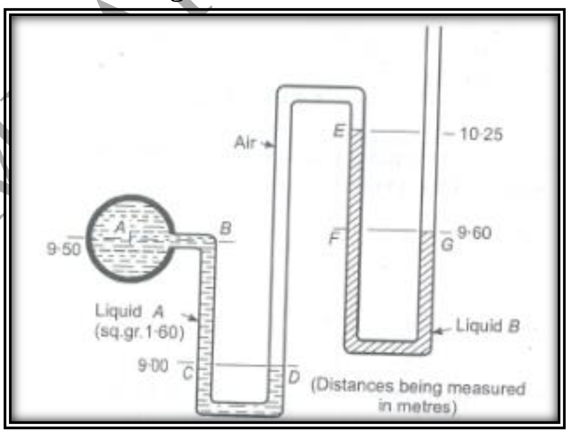
Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges- forces on planes – centre of pressure – buoyancy and floatation.

PART - A

1	Define real and ideal fluids.	BT-1
2	Write about mass density and specific weight.	BT-1
3	Distinct between statics and kinematics	BT-4
4	What is mean by specific volume and specific gravity	BT-1
5	Distinct between capillarity and surface tension.	BT-4
6	Calculate the specific weight, density and specific gravity of 1 liter liquid which weighs 7N.	BT-3
7	State viscosity and Newton's law of viscosity.	BT-1
8	Define compressibility and kinematic viscosity.	BT-1
9	Evaluate the kinematic viscosity of oil having density 981 kg/m^3. The shear stress at a point in oil is 0.2452N/m^2 and velocity gradient at that point is 0.2/sec.	BT-5
10	Determine the specific gravity of a fluid having 0.05 poise and kinematic viscosity 0.035 stokes.	BT-3
11	Calculate the minimum size of glass tube that can be used to measure water level if the capillary rise is restricted to 2 mm. Consider surface tension of water in contact with air as 0.073575 N/m.	BT-3
12	Write down the expression for capillary rise and capillary fall.	BT-2
13	Explain vapour pressure and cavitation.	BT-2
14	Two horizontal plates are placed 1.25 cm apart. The space between them is being filled with oil of viscosity 14 poises. Find the shear stress in oil if upper plate is moved with a velocity of 2.5 m/s.	BT-6
15	State Pascal's law.	BT-1
16	Describe about absolute and gauge pressure and vacuum pressure?	BT-2
17	Differentiate centre of pressure and total pressure.	BT-4
18	Discuss about buoyancy and centre of buoyancy.	BT-2
19	Give short notes on Meta centre and Hydro static Pressure.	BT-5
20	A differential manometer is connected at the two points A and B. At B pressure is 9.81N/cm^2(abs). Find the absolute pressure at A.	BT-6

PART - B

1	i) Identify the capillary effect in millimeters a glass tube of 4mm diameter, when immersed in (a) water (b) mercury. The temperature of the liquid is 20^o C and the values of the surface tension of water and mercury at 20^o C in contact with air are 0.073575 and 0.51N/m respectively. The angle of contact for water is zero that for mercury 130^o. Take specific weight of water as 9790 N/m^3. (8) ii) A 15 cm diameter vertical cylinder rotates concentrically inside another cylinder of diameter 15.10 cm. both cylinders are 25 cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12.0 Nm is required to rotate the inner cylinder at 100 rpm determine the viscosity of the fluid. (8)	BT-1
2	If the velocity profile of a liquid over a plate is a parabolic with the vertex 20 cm from the plate, where the velocity is 120 cm/sec. Analyse the velocity gradients and shear stress at a distance of 0, 10 and 20 cm from the plate, if the viscosity of the fluid is 8.5 poise.	BT-4
3	i) The dynamic viscosity of oil, used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90mm. the thickness of the oil film is 1.5 mm. (8) ii) Write down expression for capillary rise and fall. (8)	BT-6
4	i) If the velocity distribution over a plate is given by $u=2/3\ y - y^2$ in which U is the velocity in m/s at a distance y meter above the plate, determine the shear stress at y=0 and y=0.15 m. Take dynamic viscosity of fluid as 8.63 poises. (8) ii) Derive about Pascal's law.	BT-2
5	i) Two large plane surfaces are 2.4 cm apart. The space between the gap is filled with glycerin. What force is required to drag a thin plate of size 0.5 m between two large plane surfaces at a speed of 0.6 m/sec. if the thin plate is (a) in the middle gap (b) thin plate is 0.8 cm from one of the plane surfaces? Take dynamic viscosity of fluid is 8.1 poise. ii) Derive the expression for pressure head when fluid at a rest?	BT-1
6	(i) Explain the characteristics of non-Newtonian fluids in detail? (8) (ii) The velocity distribution for flow over a plate is given by $U= 2y-y^2$ where U is the velocity in m/s at a distance y meters above the plate. Determine the velocity gradient and shear stress at the boundary and 0.15m from it. (8)	BT-1
7	(i) What are the units of mass density, specific weight, dynamic viscosity and kinematic viscosity in S.I units. (4) (ii) A 400mm diameter shaft is rotating at 200 rpm in a bearing of length 120mm. if the thickness of oil film is 1.5mm and the dynamic viscosity of the oil is 0.7 $N.S/m^2$. Determine the torque required overcoming friction in bearing and power utilised in overcoming viscous resistance. Assume a linear velocity profile? (12)	BT-2

8	Calculate the capillary rise in a glass tube of 2.5 mm diameter when immersed vertically in (a) water (b) mercury. Take surface tension = 0.0725 N/m for water and = 0.52 N/m for mercury in contact with air. The specific gravity for mercury is given as 13.6 and angle of contact of mercury with glass = 130^o.	BT-3
9	The diameters of a small piston and a large piston of a hydraulic jack at 3 cm and 10 cm respectively. A force of 80 N is applied on the small piston. Find the load lifted by the large piston when: a. The pistons are at the same level b. Small piston in 40 cm above the large piston. The density of the liquid in the jack is given as 1000 kg/m^3.	BT-3
10	A U - Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs. U tube is 10 cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, Calculate the new difference in the level of mercury. Sketch the arrangement in both cases.	BT- 2
11	Through a very narrow gap of height h, a thin plate of large extent is pulled at a velocity V. On one side of the plate is oil of viscosity μ_1 and on the other side of oil of viscosity μ_2. Locate the position of the plate so that (i) the shear force on the two sides of the plate is equal; (ii) the pull required to drag the plate is minimum.	BT-1
12	For the gauge pressure of (- 25960 N/m^2) at A. Evaluate the specific gravity of the gauge liquid B as shown in fig.  	BT-5
13	(i) An open reservoir contains a liquid having density of 1.23 g/cc. At a certain point the gauge pressure is 0.31 atmosphere. At what height above the given point is the liquid level. (ii) Define viscosity. Explain the effect of temperature and pressure on viscosity of liquid and gases.	BT-4
14	(i) Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the centre of the plate is 3 m below the free surface of water. Also find the position of centre of pressure. (ii) A liquid has sp.gravity of 0.78. Find its density , sp.weight, and also the	BT-4

	weight per litre of the liquid. If the above liquid is used for lubrication between a shaft and sleeve, find the power lost in liquid for a sleeve length of 100 mm. The diameter of the shaft is 0.5 m and the thickness of the liquid film is 1 mm. Take the viscosity of the fluid as 0.5 N-s/m^2 and the speed of the shaft as 200 rpm.	

UNIT II - FLIUD KINEMATICS AND DYNAMICS

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net. Fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter and Pitot tube. Linear momentum equation and its application.

PART - A

1.	What are the types of fluid flows?	BT-1
2.	Distinguish between laminar and turbulent flow?	BT-4
3.	Differentiate compressible and incompressible flow?	BT-4
4.	Differentiate rotational and irrotational flow?	BT-4
5.	Giver detail about one dimensional and two dimensional flow?	BT-2
6.	Write about local and convective acceleration?	BT-3
7.	Define equipotential line and vorticity?	BT-1
8.	Give the relation between stream function and velocity potential function?	BT-3
9.	Describe forced and free vortex flows with examples?	BT-2
10.	Write the equation for motion for vortex flow and forced vortex flow.	BT-6
11.	State Bernouillie's equation.	BT-1
12.	Give the Euler's equation of motion	BT-6
13.	Write the expression rate of flow through venturimeter	BT-5
14.	For what purpose orifice meter is used? Define it?	BT-1
15.	What is mean by Pitot tube and give its working principle?	BT-1
16.	State momentum equation and impulse momentum equation?	BT-1
17.	What are the assumptions made in deriving Bernouillie's equation and state its applications.	BT-2
18.	Write the expression for rate of flow through venturimeter	BT-5
19.	Name the different forces present in a fluid flow. For the Eulers equation of motion, which forces are taken into consideration.	BT-3
20.	Explain about free liquid jets	BT-2

PART - B

1.	i) Describe continuity equation from principle of conservation of mass. (6) ii) Derive the continuity equation for a three dimensional incompressible flow. (10)	BT-2
2.	The velocity component for a two dimensional incompressible flow are given	BT-3

	by $u = 3x - 2y$ and $v = -3y - 2x$. Show that the velocity potential exists. Determine the velocity potential function and stream function.	
3.	Water flows through a pipe AB 1.2 m diameter at 3 m/s and then passes through a pipe BC 1.5 m diameter. At C, the pipe branches. Branch CD is 0.8 m in diameter and carries one – third of the flow in AB. The flow velocity in branch CE is 2.5 m/s. find the volume rate of flow in AB, the velocity in CD, the velocity in BC and the diameter of CE.	BT-3
4.	(i) A fluid flow field is given by $V = x^2yi+y^2zj - (2xyz+yz^2)k$ prove that it is a case of possible steady incompressible flow. Calculate the velocity and acceleration at the point (2, 1, 3). (8) (ii) A 40 cm diameter pipe, conveying water, branches into two pipes of diameters 30cm and 20cm respectively. If the average velocity in the 40 cm diameter pipe is 3m/s, find the discharge in this pipe. Also determine the velocity in 20 cm pipe if the average velocity in the 30 cm diameter pipe is 2m/s. (8)	BT-4
5.	(i) A vertical sluice gate 4 meters wide and 2 m deep is hinged at the top. A liquid of sp.gravity 1.5 stands on the upstream side of the gate up to a height of 3.5 meters above the top edge of the gate and water on the downstream side upto the top edge of the gate. Find the resultant pressure acting on the gate and the point at which the resultant pressure acts. (8) (ii) A two dimensional flow is described by the velocity components, $u = 5x^3$ and $v = -15x^2y$. Determine the stream function, velocity and acceleration at point P (x= 1m ; y = 2m) (8)	BT-5
6.	If for a two dimensional potential flow, the velocity potential function is given by $\phi = x(2y-1)$, determine the velocity at the point P(4,5). Determine also the value of stream function Ψ at the point P.	BT-1
7.	Briefly describe about velocity potential function and stream function and its relations.	BT-2
8.	Obtain the Euler's equation of motion and deduce that to Bernouillie's equation.	BT-2
9.	(i)The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper and 300 mm at the lower end, at the rate of 50 litres /s. the pipe has a slope of 1 in 30. Identify the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. (ii) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 N/cm^2(gauge) and mean velocity of 2.0 m/s. Find the total head or total energy per unit weight of the water at a cross section, which is 5m above the datum line.	BT-1
10.	(i)An oil of sp .Gr. 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil mercury differential manometer shows a reading of 25 cm. Examine the discharge of oil through the horizontal venturimeter, Take $C_D = 0.98$. (12) (ii) Write down the formula for bernoullis equation for real fluid. (4)	BT-4

11.	(i) A vertical wall is of 8 m height. A jet of water is coming out from a nozzle with a velocity of 20 m/s. The nozzle is situated at a distance of 20 m from the vertical wall. Find the angle of projection of the nozzle to the horizontal so that the jet of water just clears the top of the wall. (10) (ii) What is mean by impulse momentum equation? Derive impulse momentum equation for a fluid. (6)	BT-1
12.	A venturimeter of inlet diameter 300 mm and throat diameter 150 mm is inserted in vertical pipe carrying water flowing in the upward direction. A differential mercury manometer connected to the inlet and throat gives a reading of 200 mm. Find the discharge if the coefficient of discharge of meter is 0.98.	BT-6
13.	A 400 x 200 mm venturimeter is provided in a vertical pipe line carrying oil of relative density 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U tube mercury manometer shows a gauge deflection of 250 mm. calculate the discharge of oil, if the coefficient of meter is 0.98	BT-1
14.	(i) A pitot static tube is used to measure the velocity of water in a pipe. The stagnation pressure head is 6m and static pressure head is 5m. Calculate the velocity of flow assuming the coefficient of tub equal to 0.98 (4) (ii) A jet of water of 50 mm in diameter is moving at 15m/s. It strikes a flat plate which is inclined at 30^0 to the jet. Find the force on the plate in the direction of the jet when (a) the plate is stationary and (b) the plate is moving at 3m/s in the direction of jet. Also determine the power of the jet when the plate is moving. (12)	BT-4

UNIT III - FLOW THROUGH PIPES

Viscous flow - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy -Weisbach's equation - pipe roughness -friction factor- Moody's diagram- Major and minor losses of flow in pipes - Pipes in series and in parallel.

PART - A

1.	Define viscous flow. Write down the examples of laminar flow/viscous flow.	B.T 1
2.	Name the characteristics of laminar flow.	B.T 1
3.	Describe the factors to be determined when viscous fluid flows through the circular pipe.	B.T 1
4.	Give an expression for co efficient of friction in terms of shear stress.	B.T 1
5.	Write the expression for drop of pressure for a given length of a pipe.	B.T 1
6.	Write down the formula for Hagen Poisuille’s equation.	B.T 1
7.	Differentiate laminar and turbulent flow.	B.T 2

8.	Distinguish between Kinetic energy correction factor and momentum correction factor.	B.T 2
9.	Explain the head loss co-efficient. Also Give an expression for loss of head due to friction in viscous flow.	B.T 2
10.	Outline the velocity and shear stress distribution curve for laminar flow of an incompressible fluid through a circular pipe.	B.T 2
11.	Using Hagen Poisuille's derivation, show the formula for average velocity and velocity distribution.	B.T 3
12.	A crude oil of kinematic viscosity of 0.4 stoke is flowing through a pipe of diameter 300mm at the rate of 300 litres/sec. calculate the loss of head due to friction for a length of 50m of the pipe.	B.T 3
13.	Illustrate the different factors which influencing the frictional loss in pipe flow?	B.T 3
14.	Identify the type of flow of an oil of relative density 0.9 and dynamic viscosity 20 poise, flowing through a pipe of diameter 20 cm and giving a discharge of 10 lps.	B.T 4
15.	Compare hydraulic gradient line with total energy line.	B.T 4
16.	Explain Darcy formula. How will you determine the loss of head due to friction in pipes?	B.T 4
17.	State the significance of Moody diagram.	B.T 5
18.	Formulate an expression for loss of head due to sudden enlargement and sudden contraction of the pipes.	B.T 5
19.	Explain the terms a) major energy loss, b) minor energy loss.	B.T 6
20.	Explain about a) pipes in series b) pipes in parallel?	B.T 6

PART - B

1.	i) An oil of Sp.Gr 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 liters/sec. Find the head lost due to friction for a 500 m length of pipe. Also find the power required to maintain this flow. ii) Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using (a) Darcy formula, (b) Chezy's formula for which C = 60.	B.T 1
2.	Show that the momentum correction factor and kinetic energy correction factor for laminar flow through a circular pipe are 4/3 and 2 respectively.	B.T 1
3.	i) An oil of viscosity 0.1NS/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 5cm and of length 300m. The rate of flow of fluid through the pipe is 3.5 liters/sec. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall. ii) Find the maximum power transmitted by a jet of water discharging freely out of nozzle fitted to a pie = 300 m long and 100 mm diameter with co efficient of friction as 0.01. the available head at the nozzle is 90 m.	B.T 1

4.	i) Outline the sketch of laminar flow through circular tubes. (3) ii) Derive an expression for Hagen Poisuille's equation. (13)	B.T 1
5.	A siphon of diameter 200 mm connects two reservoirs having a difference in elevation of 15 m. The total length of the siphon is 600 mm and the summit is 4 m above the water level in the upper reservoir. If the separation takes place at 2.8 m of water absolute, Estimate the maximum length of siphon from upper reservoir to the summit. Take f =0.004 and atmospheric pressure10.3 m of water.	B.T 2
6.	i) Explain about the viscous flow and predict the expression for flow between parallel plates. ii) An oil of viscosity 1 N-s/m^2 flows between two parallel fixed plates which are kept at a distance of 50 mm apart. Find the discharge of oil between the plates. If the drop of pressure in a length of 1.2m be 3 kN/m^2. The width of the plate is 200mm.	B.T 2
7.	The difference in water surface levels in two tanks, which are connected by three pipes in series of lengths 300 m, 170 m and 210 m and of diameters 300 mm, 200 mm and 400 mm respectively, is 12m. Estimate the rate of flow of water if co – efficient of friction are 0.005, 0.0052 and 0.0048 respectively, considering: (i) minor losses also (ii) neglecting minor losses.	B.T 2
8.	i) Compare chezy's formula with Darcy's formula. (4) ii) Solve an expression for the Darcy weisbach equation. (12)	B.T 3
9.	i) A pipe of diameter 20 cm and length 2000 m is connects two reservoirs, having difference of water levels as 20 m. determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, find the increase in the discharge. Take f = 0.015 and neglect minor losses. ii) Two pipes of diameter 400mm and 200mm are each 300m long. When the pipes are connected in series the discharge through the pipeline is 0.10m^3/sec, Calculate the loss of head incurred. What would be the loss of head in the system to pass the same total discharge when the pipes are connected in parallel. Take friction factor = 0.0075 for each pipe.	B.T 3
10.	The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller is 11.772 N/cm^2. Evaluate the (i) loss of head due to sudden enlargement, (ii) pressure intensity in the large pipe, (iii) power lost due to enlargement.	B.T 4
11.	A horizontal pipe line 40 m long is connected to a water tank at one end discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow (discharge). Take Darcy's co-efficient of friction as 0.01 for both sections of the pipe.	B.T 4
12.	i) Compare and contrast the formulas for loss of head due to sudden	B.T 4

	enlargement and contraction. (4) ii) Derive an expression for the calculation of loss of head due to (a) sudden enlargement (6) (b) sudden contraction (6)	
13.	i) If a pipe line of 300 mm diameter and 3200 m long is used to pump up 50 kg per second of oil whose density is 950 kg/m^3 and whose kinematic viscosity is 2.1 stokes, the centre of the pipe line at the upper end is 40 m above than that at the lower end and the discharge at upper end is atmospheric, what is the pressure at the lower end & draw the hydraulic gradient and the total energy line. ii) A pipe line 60 cm diameter bifurcates at a Y- junction into two branches 40 cm and 30 cm in diameter. If the rate of flow in the main pipe is 1.5 m^3/s and mean velocity of flow in 30 cm diameter pipe is 7.5 m/s, determine the rate of flow in the 40 cm diameter pipe.	B.T 5
14.	At a sudden enlargement of water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10mm. Estimate the rate of flow. Draw the HGL for the system described.	B.T 6

UNIT IV - BOUNDARY LAYER

Boundary layer – definition- boundary layer on a flat plate – thickness and classification – displacement , energy and momentum thickness – Boundary layer separation and control – drag in flat plate – drag and lift coefficients.

PART – A

1	Define the term Boundary Layer.	BT-1
2	List out the assumptions made in the analysis of boundary layer development.	BT-1
3	Discuss the characteristics of laminar flow.	BT-2
4	Differentiate between Laminar boundary layer and turbulent boundary layer.	BT-4
5	State the Boundary layer theory.	BT-1
6	Illustrate the examples of formation of boundary layer in day to day life.	BT-3
7	Describe the term Laminar Sub – layer?	BT-2
8	Differentiate between displacement thickness and momentum thickness.	BT-4
9	Define energy thickness.	BT-1
10	Define boundary layer thickness.	BT-1
11	Write down the values of boundary layer thickness and drag co – efficient for Blasius's solution.	BT-6
12	List out the conditions for separation of boundary layer.	BT-1
13	Write down the Von Karman momentum integral equation.	BT-6
14	Classify the different methods of preventing the separation of boundary layers?	BT-2
15	Write down the boundary conditions for the velocity profiles.	BT-3
16	Distinguish between local co-efficient of drag and average co-efficient of drag.	BT-4

17	Sketch a diagram for drag force on a plate due to boundary layer.	BT-3
18	Discuss about the applications of Von Karman momentum integral equation.	BT-2
19	Explain the terms: Drag and Lift.	BT-5
20	Evaluate how the drag and lift acting on a body moving in a fluid of density ρ at a uniform velocity U are calculated mathematically.	BT-5

PART – B

1	Briefly explain the terms i) Laminar Boundary Layer ii) Turbulent Boundary Layer iii) Boundary Layer Thickness iv) Laminar Sub-Layer	BT-6
2	Define the terms displacement thickness and momentum thickness and also derive an expression for the displacement thickness and momentum thickness in boundary layer with necessary assumptions.	BT-1
3	i. Calculate the thickness of the boundary layer at the trailing edge of smooth plate of length 4 m and of the width 1.5 m, when the plate is moving with a velocity of 4 m/s in stationary air. Take kinematic viscosity of air as 1.5×10^{-5} m^2/s. ii. Oil with a free-stream velocity of 3 m/s flows over a thin plate of 1.25 m wide and 2 m long. Calculate the boundary layer thickness at mid length and also calculate the total double sided resistance of the plate. Take density as 860 kg/m^3 and kinematic viscosity as 10^{-5} m^2/s.	BT-3
4	Calculate the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $u/U = y/\delta$, where u is the velocity at a distance y from the plate and u = U at $y = \delta$, where δ = boundary layer thickness. Also calculate the value of δ^*/θ.	BT-3
5	Analyse the displacement thickness, the momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $u/U = 2 (y/ \delta) - (y/ \delta)^2$.	BT-4
6	For the following velocity profiles, Examine whether the flow has or on the verge of separation or will attach with the surface: i. $u/U = 3/2 (y/ \delta) - 1/2 (y/ \delta)^3$ ii. $u/U = 2 (y/ \delta)^2 - (y/ \delta)^3$ iii. $u/U = - 2 (y/ \delta) + (y/ \delta)^2$	BT-1
7	For the velocity profile for laminar boundary layer $u/U = 2(y/ \delta) - 2(y/ \delta)^3 + (y/ \delta)^4$ derive an expression for boundary layer thickness, shear stress, drag force on one side of the plate and co – efficient of drag in terms of Reynold number.	BT-1
8	A thin plate is moving in still atmospheric air at a velocity of 5 m/s. The length of the plate is 0.6 m and width is 0.5 m. Estimate : i. The thickness of the boundary layer at the end of the plate ii. Drag force on one side of the plate. Take density of air as 1.24 kg/m^3 and kinematic viscosity of 0.15 stokes.	BT-2

9	For the velocity profile for laminar boundary layer u/U = 3/2 (y/ δ) –1/2 $(y/\delta)^3$ find the thickness of the boundary layer and the shear stress 1.5 m from the leading edge of a plate. The plate is 2 m long and 1.4 m wide and is placed in water which is moving with a velocity of 200 mm per second. Estimate the total drag force on the plate if μ for water = 0.01 poise.	BT-2
10	A plate of length 750 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 5 m/s. If the crude oil has a specific gravity of 0.8 and kinematic viscosity of 1 stoke, Estimate: i. Boundary layer thickness at the middle of the plate. ii. Shear stress at the middle of the plate. iii. Friction drag on one side of the plate.	BT-2
11	For the velocity profile for laminar boundary flow u/U = sin $[\frac{\pi}{2}\frac{y}{\delta}]$. Obtain an expression for boundary layer thickness, shear stress, drag force on one side of the plate and co – efficient of drag in terms of Reynold number.	BT-4
12	Obtain an expression for a drag force on a flat plate due to boundary layer.	BT-4
13	A flat plate of 2 m width and 5 m length is kept parallel to air flowing at 4 m/s velocity. Find i. The length of the plate over which the boundary layer is laminar ii. Boundary layer thickness iii. Shear stress Take density = 1.2 kg/m^3 and kinematic viscosity as 1.4 × 10^{-5} m^2/s.	BT-1
14	Air is flowing over a flat plate of 500 mm long and 600 mm wide with a velocity of 4 m/s. The kinematic viscosity of air is 0.15 stokes. Determine the i. Boundary layer thickness at the end of the plate ii. Shear stress at 200 mm from the leading edge iii. Drag force on one side of the plate. Take the velocity profile over the plate as u/U = sin $[\frac{\pi}{2}\frac{y}{\delta}]$ and density of air = 1.24 kg/m^3.	BT-5

UNIT V - DIMENSIONAL ANALYSIS AND MODEL STUDIES

Fundamental dimensions - dimensional homogeneity - Rayleigh"s method and Buckingham Pi-Theorem - Dimensionless parameters - Similitude and model studies - Distorted Models.

PART – A

1	Define the term dimensional homogeneity.	BT-1
2	Differentiate between Geometric similarity and Kinematic similarity.	BT-4
3	List the steps in determining the π groups.	BT-1
4	Examine whether the equation V = √2gH is dimensionally homogenous.	BT-4
5	Classify the methods of dimensional analysis.	BT-2
6	Define Similitude and Scale ratio.	BT-1
7	Evaluate the dimensions of the following physical quantities:	BT-5

	a. Pressure b. Surface tension c. Dynamic viscosity d. Kinematic viscosity	
8	Write short note on Dynamic similarity.	BT-3
9	Discuss about the applications of model testing.	BT-2
10	Define dimensionless numbers.	BT-1
11	Describe the three demerits of a distorted model.	BT-2
12	Write two examples of a fluid flow situation where Froude model law is applied.	BT-6
13	Differentiate between model and prototype.	BT-4
14	State the Buckingham's π-theorem.	BT-1
15	Define Reynold's number and Froude's number.	BT-1
16	Illustrate the significance of Reynolds number and prandtl number.	BT-3
17	Enumerate the advantages of model testing.	BT-5
18	Write short note on undistorted model.	BT-3
19	Discuss about the distorted model.	BT-2
20	Explain the uses of dimensional homogeneity.	BT-6

PART – B

1.	i. State and explain about the Buckingham's π-theorem. ii. Check the dimensional homogeneity of the following common equations in the field of hydraulics. a) $Q = C_d. a.\sqrt{2gH}$ b) $V = C\sqrt{mi}$	BT-1
2.	The efficiency η of a fan depends on density 'ρ', dynamic viscosity 'μ', and angular velocity 'ω', diameter D of the rotor and the discharge Q. Evaluate η in terms of dimensionless parameters using Buckingham's π method.	BT-5
3.	The resisting force (R) of a supersonic flight can be considered as dependent upon length of aircraft (l), velocity (V), air viscosity 'μ', air density 'ρ', and bulk modulus of air ' k'. State the functional relationship between these variables and the resisting force.	BT-1
4.	By dimensional analysis, Show that the power P developed by a hydraulic turbine is given by $P = \rho N^3 D^5 f\,[N^2 D^2/ gH]$ where ρ - mass density of liquid, N - rotational speed, D – diameter of runner, H working head and g - acceleration due to gravity.	BT-3
5.	A 7.2 m height and 15 m long spillway discharge 94 m^3/s, under a head of 2 m. If a 1:9 scale model of this spillway is to be constructed, determine model dimensions, head over spillway model and the model discharge. If model experience a force of 7500N, Calculate the force on the prototype.	BT-3
6.	The variables controlling the motion of a floating vessel through water the drag force F, speed V, length L, density ρ, and dynamic viscosity μ of water and acceleration due to gravity g. Construct an expression for F by dimensional analysis.	BT-6
7.	Using Buckingham's π theorem, Examine whether the velocity through a circular pipe orifice is given by, $V = \sqrt{2gH}\phi\,[\,D/H\,,\ \mu/\,\rho vH\,]$ where H = Head causing flow, D = diameter of orifice, μ = coefficient of viscosity ρ = mass density, g = acceleration due to gravity.	BT-4
8.	i. An oil of specific gravity 0.91 and viscosity of 0.03 poise is to be transported at the rate of 3 m^3/s through a 1.3 m diameter pipe, Model tests were conducted on	BT-2

	130 mm diameter pipe using water having a viscosity of 0.01 poise. Estimate the velocity of flow and discharge in the model. ii. Discuss briefly the three types of Similarities between the model and the prototype.	
9.	i. What is a distorted model? How it differs from an undistorted model. Discuss the advantages and disadvantages of distorted models. ii. A spill way model built upto a scale of 1/10 is discharging water with a velocity of 1 m/s, under a head of 100 mm. Estimate the velocity of water of the prototype, if the head of water over the prototype is 5.5 m.	BT-2
10.	The frictional torque T of a disc diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5 N^2 \rho \phi [\mu / D^2 N \rho]$. Prove this by the method of dimensions.	BT-4
11	It is desired to obtain the dynamic similarity between a 30 cm diameter pipe carrying linseed oil at 0.5 m^3/s and a 5 m diameter pipe carrying water. What should be the rate of flow of water in lps. If the pressure loss in the model is 196 N/m^2, Estimate the pressure loss in the prototype pipe. Kinematic viscosities of linseed oil and water are 0.457 and 0.0113 stokes respectively. Specific gravity of linseed oil 0.82.	BT-2
12	A spillway model is to be built to a scale ratio of 1:40 across a flume of 600 mm width. The prototype is 10 m high and maximum head expected is 1.5 m. i. Calculate the height of the model and the head on the model. ii. Calculate the flow over the prototype when the flow over the model is 12 lps. iii. If a negative pressure of 0.15 m occurs in the model, what will be the negative pressure in the prototype? Is this practically possible to occur. State it.	BT-1
13	i. The pressure drop in an aeroplane model of size 1/10 of its prototype is 80 N/cm^2. The model is tested in water. Analyse the corresponding pressure drop in the prototype. Take density of air = 1.24 kg/m^3. The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise. ii. A 1.64 model is constructed on open channel in concrete which has mannings N = 0.014. find the value of N for the model.s	BT-4
14	i. List out the classification of models and explain it and also discuss about the scale ratios for distorted models. ii. List out the types of forces acting in a moving fluid and explain it briefly.	BT-1

VALLIAMMAI ENGINEERING COLLEGE
DEPARTMENT OF CIVIL ENGINEERING

SUBJECT CODE: CE6303 **YEAR : II**

SUBJECT NAME: MECHANICS OF FLUIDS **SEM : III**

		BT -1	BT-2	BT-3	BT-4	BT-5	BT-6
UNIT-I	Part - A	6	4	3	3	2	2
UNIT-II	Part - A	6	4	3	3	2	2
UNIT-III	Part - A	6	4	3	3	2	2
UNIT-IV	Part - A	6	4	3	3	2	2
UNIT-V	Part - A	6	4	3	3	2	2
Total questions	100	30	20	15	15	10	10
Total questions = 100							

		BT -1	BT-2	BT-3	BT-4	BT-5	BT-6
UNIT-I	Part - B	4	3	2	3	1	1
UNIT-II	Part - B	4	3	2	3	1	1
UNIT-III	Part - B	4	3	2	3	1	1
UNIT-IV	Part - B	4	3	2	3	1	1
UNIT-V	Part - B	4	3	2	3	1	1
Total questions	70	20	15	15	10	5	5
	%	30 %	20%	15%	15%	`10%	10%
Total questions = 100							

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